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FIGURE

TABLE

9. WAG 6, OU 6-04, EBR-15, RADIONUCLIDE CONTAMINATED SOIL AREAS

9.1 Site Description

Experimental Breeder Reactor (EBR)-15 consists of radionuclide-contaminated soil in the area of EBR-1 as shown in Figure 5-1. The soil contamination is believed to have been caused by two spills, one in 1955 and another in 1956, of NaK coolant containing various radionuclides; and by a NaK stabilization process when NaK coolant was removed and processed during EBR-1 decontamination and decommissioning (D&D) activities conducted in 1975.

A 6 × 9-m (20 × 30-ft) concrete disposal pad, located west of EBR-601, was used for disposal of the NaK, and retained liquid were used to wash nonradioactive residual NaK from reactor components. In 1955, radioactive NaK from the disposal pad was inadvertently released into the soil surrounding the pad. No attempt was made to remove the contaminated soil at that time. During the D&D&D activities from 1973 to 1975, the NaK processing equipment, which was set up on the NaK disposal pad, processed 20,818 L (5,500 gal) of radioactive NaK. Twice in 1975, radioactive NaK was released from the pad into the surrounding soil. Subsequently, the contaminated soil, the processing plant and the NaK disposal pad were removed and transported to the Radioactive Waste Management Complex (RWMC) for disposal (U.S. Department of Energy Idaho Operations Office [DOE-ID] 1999).

9.2 Previous Investigations

During routine radiation surveys in 1988, cesium-137 (Cs-137) and strontium-90 (Sr-90) surface soil contamination was found in two areas. Area 1 was located approximately 21 m (70 ft) west of the EBR-1 reactor building (EBR-601) and annex (EBR-601A). Area 2 was located approximately 122 m (400 ft) southeast of EBR-601 and EBR-601A. Soil samples collected from Areas 1 and 2 showed elevated levels of Cs-137 and Sr-90. The maximum concentrations were 2,090 ± 125 and 4.04 ± 0.29 pCi/g for Cs-137 and Sr-90, respectively.

In 1989, soil samples were collected at 0.6 m (2 ft) and 0.9 m (3 ft) belowground surfaces (bgs) and analyzed for radionuclides, volatile organic compounds (VOCs), metals, and pH. The results indicated the presence of Cs-137 and other radionuclides that are typically generated as activation products. Results were obtained for a limited number of VOCs for seven soil samples. The results of the 1989 sampling effort are discussed in detail in Section 9.3.

In September 1989, an attempt was made to excavate the top 7.6 cm (3 in.) of soil from Area 1. During this excavation, winds with velocities up to 32 km/hr (20 mph) began spreading the contaminated material to a larger area. The project radiological control technician halted the excavation because of the high winds. The increased area of contamination was surveyed after the project was halted and designated as Area 3. The excavated contaminated soil from Area 1 was boxed and transported to the RWMC, and the excavated area was backfilled with clean soil. The boxed soil was returned from the RWMC to the site, because the radioactivity in the soil was too low to meet RWMC waste acceptance criteria. The returned soil was placed in a layer approximately 10 cm (4 in.) thick over the clean soil used to backfill the excavation at Area 1 and then was covered with more clean soil.

A radiation survey for beta-gamma radiation was conducted in the spring of 1991. Areas exceeding 100 cpm above background levels were flagged, and the area was fenced to preclude exposure to contamination. The fence enclosed all three areas previously identified.

In April 1992, a more detailed radiation survey was conducted within the fenced area to better define the extent of contamination. After the contaminated area had been delineated, a surfactant (Wen-Don) was sprayed over the soil to reduce further spread of contamination. The contaminated soil covered a combined area of approximately 6,132 m^2 (66,000 ft^2) within the fenced area.

During Phase II (April through June 1994) of the operable unit (OU) 10-06 remedial investigation (RI)/feasibility study (FS), approximately 134 samples collected at various depths ranging from 0.1 to 2.6 m (0.33 to 8.5 ft) from EBR-15 showed that radionuclide concentrations were high enough to warrant accelerated cleanup, and a nontime-critical removal action (NTCRA) was approved.

The OU 10-06 NTCRA (Jessmore et al. 1996) was performed between September 12 and October 13, 1995. This activity included excavation of radionuclide-contaminated soil from all detectable sources within the EBR-1 perimeter fence. Water was used for dust suppression. Sensitive field instruments (sodium-iodide [NaI] scintillometers) were used to detect soil contaminated with Cs-137 and other gamma-emitting radionuclides, and these soils were removed. All radionuclide-contaminated soil removed from the EBR-15 excavation was placed in covered dump trucks and delivered to the Test Reactor Area (TRA) Warm Waste Pond. The total volume of soil excavated from EBR-15 was 980 m^3 (1,279 yd^3). The average depth of the excavation was approximately 31.8 cm (12.5 in.), with the deepest excavations occurring in Area 2 (approximately 1.2 m [4 ft]) and Area 1 (approximately 0.9 m [3 ft]) (DOE-ID 1999).

Cleanup was based on preliminary remediation goal (PRG) concentrations calculated in the Engineering Evaluation/Cost Analysis for OU 10-06 (Greenwell et al. 1995). Verification samples collected after the excavation was complete showed only residual Cs-137. All concentrations were less than the Cs-137 PRG of 16.7 pCi/g, except for one small area around a fence post where all contamination could not be removed (DOE-ID 1999). During the NTCRA, a piece of pipe was encountered and excavated. It was under only a few inches of soil, was not connected at either end, and was not shown on EBR-I "as-built" drawings. Field instruments detected radiological contamination inside the pipe. The pipe was turned over to the D&D&D Program for disposal.[a] It is possible that other contaminated pipe exists that was not uncovered during the OU 10-06 NTCRA.[b] Figure 9-1 is an aerial photograph of the EBR-I and Boiling Water Reactor Experiment (BORAX) area that was taken in 1996.

Summary statistics and analytical results for the EBR-15 soil samples evaluated for this RI/baseline risk assessment (BRA) are provided in Appendix C.

9.3 Nature and Extent of Contamination

As previously discussed, the 1989 soil sampling results indicated that only Cs-137 was detected above the preliminary remediation goal (PRG). However, the results in the Waste Area Group (WAG) 10 database indicate that cerium-141 (Ce-141), cobalt-58 (Co-58), chromium-51 (Cr-51), iron-59 (Fe-59), hafnium-181 (Hf-181), mercury-203 (Hg-203), manganese-54 (Mn-54), niobium-95 (Nb-95), rhodium-106 (Rh-106), ruthenium-103 (Ru-103), antimony-124 (Sb-124), scandium-46 (Sc-46), tantalum-182 (Ta-182), zinc-65 (Zn-65), and zirconium-95 (Zr-95) were shown as rejected detects. These data were reported directly from the Radioactive Materials Laboratory (RML) in raw form and did not undergo a

a. Thomas Haney, personal communication.

b. Thomas Haney, personal communication.

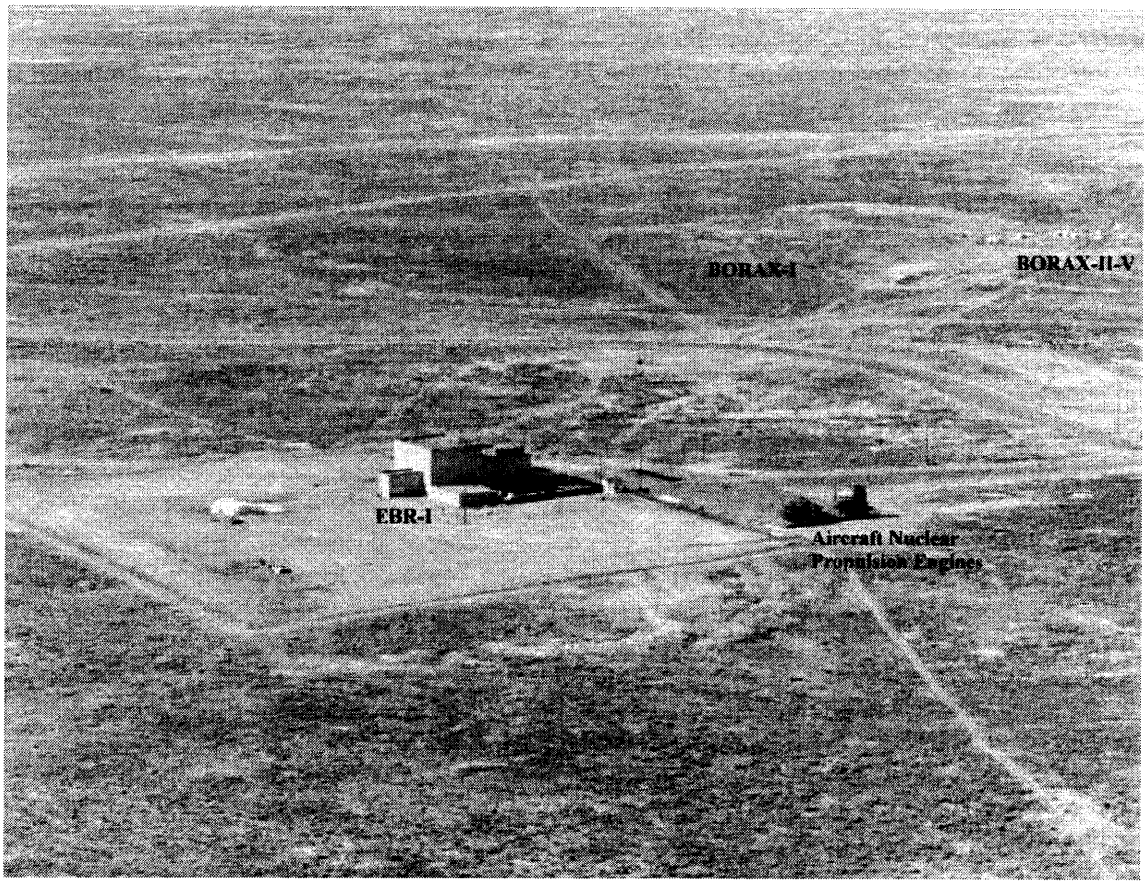

Figure 9-1. Aerial view of the EBR-I and BORAX area, looking northeast.

data validation. These radionuclides were rejected for the following reasons: the uncertainty was too high to be accepted by the analyst, the radionuclide had no supporting photopeaks to make a judgement, and the graphical display of analyzed photopeaks showed unacceptable photopeak fitting results. All of these radionuclides are activation products and have a half-life of one year or less. Therefore, it is unlikely that these short-lived activation products would exist 37 years after the reactor was shut down.

The VOC samples collected in 1989 were sent offsite for analysis. All the VOC results were below the practical quantitation limits. The WAG 10 database indicates that dimethyl disulfide was detected. There were three samples that indicated a positive detection. However, these three samples were flagged as 'J2,' which indicates an estimated value. Dimethyl disulfide was not a target compound, and consequently, the detection instrumentation was not calibrated to quantitatively measure the abundance of the compound. It is unlikely that this compound is still present at the site in any detectable quantities, due to the extremely volatile nature of dimethyl disulfide and the length of time (11 years) since the samples were collected.

The defining event for the current nature and extent of radionuclide-contaminated soil at EBR-15 was the OU 10-06 NTCRA. The pre- and postremediation contamination footprints bear little resemblance to each other. Before the removal action, radionuclide-contaminated soil covered an area of approximately 0.66 acres. This is based on the results of a combination of in situ measurements and soil sampling and laboratory analysis investigations, and concentrations of Cs-137 reaching 14,600 ± 1,000 pCi/g. After the removal action, radionuclide-contaminated soil concentrations were

reduced to below the cleanup goal in approximately 99% of this area. Soil removal was guided by sensitive in situ radiation detectors and was verified by soil sampling and laboratory analysis. The gamma-ray analyses for the 14 postremediation soil samples collected from EBR-15 were statistically positive for Cs-137 (Table 9-1). Concentrations of Cs-137 ranged from 0.1 ± 0.03 pCi/g to 11.3 ± 0.8 pCi/g. The highest level of Cs-137 was approximately 1.5 times less than the PRG of 17 pCi/g and 13.8 times greater than the 0.82 pCi/g area background (Rood 1995). The mean concentration of Cs-137 in the EBR-15 verification samples was approximately 1.8 ± 0.1 pCi/g. These data verify that residual radionuclide-contaminated soil concentrations are in compliance with removal action PRGs.

9.4 Preliminary Screening

The soil data collected from the 1989 sampling effort were screened for contaminants of potential concern (COPCs). The results of that screen are presented in Appendix C. The human health risk assessment (HHRA) and the ecological risk assessment (ERA) screening methodology are discussed in Section 4 and presented in detail in Appendices D and F, respectively. After screening, no COPCs were found to present a risk to human health or ecological receptors; therefore, no contaminants were retained for the HHRA or ERA.

Table 9-1. EBR-15 verification sample results.

Sample No.	Cs-137 Concentration (pCi/g)	Exceed PRG? Yes/No
10610201R4	2.6 ± 0.2	NO
10610301R4	ND	NO
10610401R4	1.4 ± 0.1	NO
10610501R4	0.22 ± 0.03	NO
10610601R4	0.11 ± 0.02	NO
10610701R4	11.3 ± 0.8	NO
10620601R4	0.8 ± 0.09	NO
10620701R4	1.0 ± 0.1	NO
10620801R4	0.25 ± 0.03	NO
10620901R4	0.5 ± 0.05	NO
10621001R4	1.0 ± 0.1	NO
10621101R4	2.1 ± 0.2	NO
10621201R4	0.12 ± 0.03	NO
10621202R4	0.1 ± 0.03	NO
10621301R4	3.3 ± 0.2	NO
10620001R4	ND	NO
10620002R4	ND	NO

9.5 Risk Assessment

Appendix C contains both summary statistics and exposure point concentrations for EBR-15.

9.5.1 Human Health

No HHRA was performed for this site.

9.5.2 Ecological

No ERA was performed for this site.

9.5.3 Native American

The INEEL is within the aboriginal territories of the Shoshone-Bannock Tribes. A variety of natural and cultural resources and areas that directly reflect tribal cultural heritage and native landscape ecology are preserved on the INEEL. These resources are important to the Shoshone-Bannock Tribes in maintaining tribal spiritual and cultural values and activities, oral tradition and history, mental and economic well being, and overall quality of life. Appendix A contains a qualitative analysis of WAGs 6 and 10 prepared by the Shoshone-Bannock Tribal Risk Assessment Committee. General tribal concerns about EBR-I and associated release sites are summarized in Section 6.2.4.

9.6 Uncertainties

Potentially contaminated buried piping may exist on the site. If contaminated piping exists, it is also possible that contaminated soil will be discovered when the facility undergoes D&D&D in the future. Lack of toxicity data for several COPCs requiring qualitative evaluations may result in an underestimate of risk to ecological receptors, although this is unlikely.

9.7 Conclusions and Recommendations

Contaminant concentrations, in postremediation soil samples collected in 1995, were all below background or PRG/ecologically based screening levels (EBSL). The PRG used for screening out COPCs for this site was based on the OU 10-06 removal action criteria in Greenwell et al. 1995. Contaminants for which no EBSL was available are volatile, have short half-lives, and are at low concentrations. Contaminants for which there was not toxicity data available were evaluated qualitatively. No COPCs for the HHRA or the ERA were identified for this site. Therefore, this site is recommended for no further action and will not be evaluated in the FS.

9.8 References

DOE-ID, April 1999, *Work Plan for Waste Area Groups 6 and 10 Operable Unit 10-04 Comprehensive Remedial Investigation/Feasibility Study*, DOE/ID-10554.

Greenwell, R. Doug, Richard C Marty, Eric C. Miller, and Susan M. Burns, 1995, *Engineering Evaluation/Cost Analysis for Operable Unit 10-06 Radionuclide-Contaminated Soils Removal Action at the Idaho National Engineering Laboratory, Volume III,* INEL-95/0259, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, June 1995.

Jessmore et al., 1996, *OU 10-06 Remedial Investigation/Feasibility Study for Operable Unit 10-06: Radionuclide-Contaminated Soils at the Idaho National Engineering Laboratory (DRAFT) Volume I and II*, Revision 1.

Rood, S.M., February 1995, *Background Dose Equivalent Rates And Surficial Soil Metal And Radionuclide Concentrations For The INEEL*, INEL-94/0250.

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FIGURES

TABLES

10. WAG 10, OU 10-01, LCCDA-01 AND LCCDA-02, DISPOSAL PITS 1 AND 2

10.1 Site Description

The Liquid Corrosive Chemical Disposal Area (LCCDA) consisted of two surface pits that were used to dispose of a variety of liquid corrosive chemicals. Figure 10-1 is a photograph of one of the pits (LCCDA-02) taken in 1980.

The LCCDA-01 Old Disposal Pit was an unlined pit that was used for disposal of corrosive liquids from 1960 to 1971. The LCCDA-01 pit is assumed to have been approximately 1.5 to 1.8 m (5 to 6 ft) deep and 3.0 × 3.0 m (10 × 10 ft) wide. Chemicals disposed in the pit include KOH, NaOH, $NaHCO_3$, NH_4HCO_3, H_2SO_4, HNO_3, H_4PO_3, HCl, HBr, and ZnBr. These chemicals were poured into the pit and allowed to neutralize naturally, or through disposal of acids and bases together. The LCCDA-01 pit was abandoned and backfilled in 1971 (DOE-ID 1999).

The LCCDA-02 Limestone Treatment and Disposal Pit was used from 1971, when use of LCCDA-01 ceased, until 1980 (Figure 10-1). Similar to LCCDA-01, the chemicals disposed in the pit include KOH, NaOH, $NaHCO_3$, NH_4HCO_3, H_2SO_4, HNO_3, H_4PO_3, HCl, HBr, and ZnBr. The LCCDA-02 pit was 3.0 × 4.5 × 3.0 m (10 × 15 × 10 ft) wide and filled with as much as 1.8 m (6 ft) of limestone pellets to aid in the acid neutralization process. Suspected disposal of waste oil and solvents to LCCDA has not been confirmed, and previous investigations have not detected contaminants in the pit materials indicative of waste oil or solvent contamination. A metal truck ramp that was used during placement of chemicals in LCCDA-02 was buried in the pit when the site was backfilled. Closure records indicate that LCCDA-02 was also regraded and revegetated in 1980 (DOE-ID 1997, 1999).

10.2 Previous Investigations

The LCCDA-01 pit was sampled in 1988, as part of the DOE Environmental Survey. Three boreholes were placed and, at that time, assumed to be within the pit boundaries based on the site knowledge and field observations by the survey field team (Hull et al. 1994). Figure 10-2 illustrates the approximate locations of the 1988 boreholes. One sample from each borehole was collected from the 0.6-m (2-ft) interval immediately above the point of refusal of the auger and analyzed for metals and soil pH. The three samples were collected at 2.4 to 2.7 m (8 to 9 ft), 2.7 to 3.3 m (9 to 11 ft), and 3.6 to 4.2 m (12 to 14 ft). Shallow surface soil samples were collected at locations offset from the boreholes by 0.6 m (2 ft) and analyzed for volatile organic compounds (VOCs). Hull et al. (1994) concluded that barium in LCCDA-01 was slightly in excess of background levels, indicating potential contamination. The VOCs detected in the shallow surface soil samples were at levels that could be attributed to laboratory contamination (Hull et al. 1994).

The LCCDA-02 pit was also sampled in 1988, as part of the DOE Environmental Survey. Two boreholes were placed and, at that time, assumed to be within the pit boundaries based on the site knowledge and field observations by the survey field team (Figure 10-2). One sample from each borehole was collected from the 0.6-m (2-ft) interval immediately above the point of refusal of the auger and analyzed for metals and soil pH. The two belowground samples (bgs) collected from LCCDA-02 were located at 1.5 to 2.1 m (5 to 7 ft) and 2.4 to 3.0 m (8 to 10 ft). Shallow surface soil samples were collected at locations offset 0.6m (2 ft) from each borehole location and analyzed for VOCs. Hull et al. (1994) concluded that beryllium and vanadium in LCCDA-02 were slightly in excess of background levels, indicating potential contamination. According to Hull et al. (1994), the VOCs detected in the shallow surface soil samples were at levels that could be attributed to laboratory contamination.

Figure 10-1. LCCDA-02 disposal pit showing ground ramp and access gate.

In 1993 and 1994, a Track 2 investigation of LCCDA included characterization using ground penetrating radar, seismic refraction, and electromagnetic terrain conductivity geophysical surveys. The characterization efforts were used to identify the locations of the pits for sampling purposes, determine the depth to basalt bedrock, and detect any contaminant plumes moving laterally away from the pits in the surface sedimentary materials (EG&G 1993). Figure 10-2 illustrates the lateral pit dimensions as delineated by these methods and shows the borehole locations for the Track 2 investigation (Hull et al. 1994).

Based on the results of the Track 2 geophysical survey, one borehole was placed approximately at the center of the LCCDA-01 pit to enable field-screening for contaminants. The borehole was completed to 3 m (10 ft), where basalt was encountered. Samples were screened for VOCs, polychlorinated biphenyls (PCBs), and gamma-emitting radionuclides. The screening results did not indicate contamination by VOCs or PCBs, and no samples were submitted for VOC or PCB analysis. Based on the results of the radiological screen, the sample from the 0- to 0.9-m (0- to 3-ft) interval of the LCCDA-01 borehole was submitted for analysis. In addition, surface soil samples were later collected for radiological screening from 0 to 5.1 cm (0 to 2 in.) and from 5.1 to 10.2 cm (2 to 4 in.). Aliquots from the 0 to 0.9-m (0 to 3-ft) interval as well as the 0- to 5.1-cm (0- to 2-in.) and 5.1- to 10.2-cm (2- to 4-in.) interval were obtained. All sampling intervals were analyzed for metals, semi-volatile organic compounds (SVOCs), and soil pH.

Based on the results from the Track 2 geophysical survey, six exploratory boreholes and two exploratory pits were placed in LCCDA-02 in areas where geophysical anomalies were observed to assess the lateral and vertical extent of Pit 2. Although limestone was encountered in two boreholes, and parts of the old truck ramp and gravel were encountered in the two pits, no samples were collected.

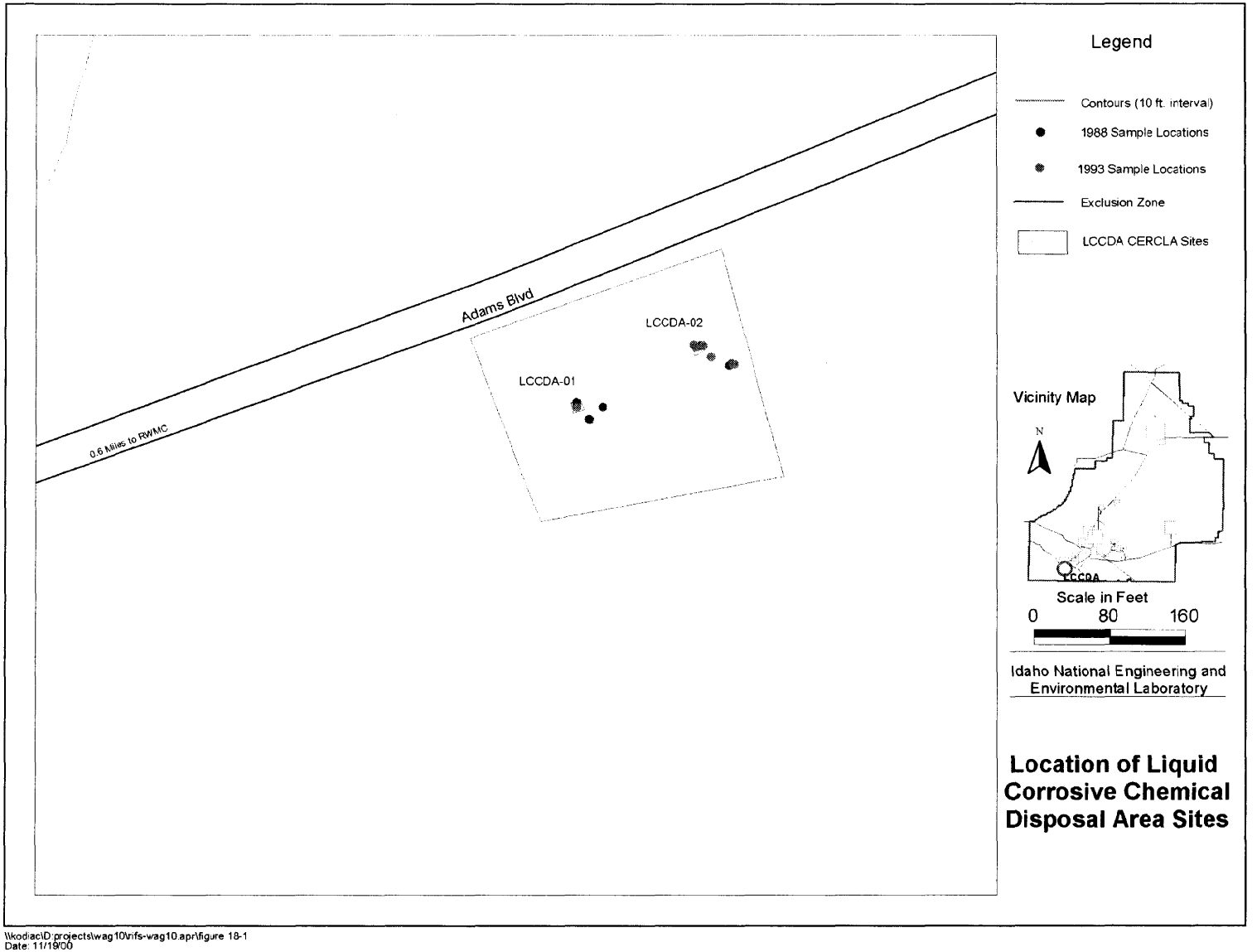

Figure 10-2. Location of LCCDA site.

Further investigations of the LCCDA pits were initiated in 1997 to determine whether waste oil and solvents were disposed in the pits, and to further characterize radionuclide-contaminated surface soil detected during the 1994 Track 2 investigation. To accomplish this, a passive soil gas survey for detection of VOCs and SVOCs was performed and surface soil sampling for radionuclide analyses was conducted. The radionuclides detected in surface soil were U-234, U-235, U-238, Sr-90, and Cs-137 (DOE-ID 1997).

Results from the 1997 soil gas survey yielded detectable levels of 1,1,1-trichloroethane (TCA), carbon tetrachloride (CCl_4), trichloroethene (TCE), and chloroform vapors. Of these, the contaminant with the highest relative radionuclide concentration was CCl_4, followed by TCE. Background grids approximately 462 m (1,500 ft) east (toward the Experimental Breeder Reactor [EBR-I]) and west (toward the Radioactive Waste Management Complex [RWMC]) were sampled for organic compounds. All the compounds detected at LCCDA were also detected in the two background grids however, maximum values were consistently lower toward EBR-I and higher toward RWMC for CCl_4, TCE, and chloroform. Because of the known organic vapor plume associated with the RWMC, it is difficult to attribute the detected organic contamination to past waste disposal activities at the LCCDA (DOE-ID 1999).

10.3 Nature and Extent of Contamination

10.3.1 LCCDA-01 Nature and Extent

Based on the 1988 Environmental Survey data, it is unlikely that VOC contamination is present between 2.4 and 3.3 m (8 and 11 ft) bgs. The solvent 1,1,2-TCA was detected at very low levels, and the detections of methylene chloride and acetone are likely to be associated with laboratory blank contamination. Some natural biodegradation of VOCs may have occurred since the 1988 detections.

Data from a screening investigation in 1993 also indicate some surficial radionuclide contamination at the site. The maximum detected concentrations for Sr-90 and Cs-137 (10 pCi/g and 9.2 pCi/g, respectively) occurred at the 5.1- to 10.2-cm (2- to 4-in.) depth. Other radionuclides were detected, including Ra-226, Sr-89, U-234, U-235, and U-238, during the 1997 surface sampling effort. The maximum detected activities for these radionuclides occurred at the 0- to 0.1-m (0- to 0.33-ft) depth interval, as follows:

- Ra-226 7 ± 1 pCi/g
- Sr-89 1.8 ± 0.6 pCi/g
- U-234 5.6 ± 0.4 pCi/g
- U-235 0.24 ± 0.03 pCi/g
- U-238 5.5 ± 0.3 pCi/g.

Although Sr-89 was detected, it can be eliminated as a contaminant of potential concern (COPC) because of its short half-life of 50.52 days.

Results from the 1988 DOE Environmental Survey and the 1993–1994 Track 2 investigation indicate that metals contamination exists at this site. Metals detected include:

- Arsenic, detected within background concentrations in four samples, at depths from 0 to 3.3 m (0 to 10 ft). However, concentration are within the arsenic regional background ranges discussed in Appendix K.

- Barium, detected above background concentrations in three samples, at depths from 0 to 0.9 m (0 to 3 ft)
- Beryllium, detected above background concentrations in six samples, at depths from 0 to 3.3 m (0 to 10 ft), with the maximum concentration (3.3 mg/kg) occurring at 0 to 0.9 m (0 to 3 ft)
- Cobalt, detected in eight samples, only one of which exceeded background concentrations, at a depth of 1.5 to 2.1 m (5 to 7 ft)
- Copper, detected above background concentrations in six samples, with the maximum concentration occurring from 2.4 to 2.7 m (8 to 9 ft)
- Manganese, detected above background concentrations in four samples, at depths from 1.5 to 3.3 m (5 to 11 ft)
- Mercury, detected in one sample in the 1988 data set, at a depth of 2.7 to 3.3 m (9 to 11 ft)
- Silver, detected in one sample in the 1993 data, but flagged "BNJF," indicating an estimated value at or below the contract-required detection limit (CRDL)
- Vanadium, detected at concentrations at or below background levels.

10.3.2 LCCDA-02 Nature and Extent

Sample results for metals and VOCs were available only from the 1988 sampling. There were only two detections of VOCs in the 1988 data: methylene chloride at 0.003 mg/kg, and 1,1,2-TCA at 0.008 mg/kg.

Sample results for metals were limited to two depth intervals: 1.6 to 2.1 m (5 to 7 ft) bgs, and 2.4 to 3.3 m (8 to 10 ft) bgs. There are no surface soil results for metals. Detected metals included barium, beryllium, chromium, cobalt, copper, manganese, nickel, vanadium, and zinc.

Although radionuclides were not a primary component of the waste stream to LCCDA, some low concentrations of Cs-137 and Sr-90 have been detected in the surface soil at LCCDA-01, which is concluded to have been present in the backfill dirt. It is possible that similar concentrations are present in the surface soil at LCCDA-02.

Three surface soil samples were collected from 0 to 0.1 m (0 to 0.33 ft) bgs and analyzed for radionuclides in 1997. The analysis detected Cs-137 (maximum concentration of 0.765 pCi/g) in all three samples. There were two Pu-239 detections among the three samples, with a maximum concentration of 0.0304 pCi/g. All three samples also yielded detections of Ra-226, with a maximum concentration of 2.6 pCi/g. In addition, U-234, U-235, and U-238 were detected in all three samples with all concentrations less than 1 pCi/g.

In summary, the data indicate some low-level radionuclide contamination in the surface soil, and limited metals and VOC contamination in the subsurface soil at the LCCDA-02 site.

10.4 Preliminary Screening

For LCCDA-01, the soil data collected from the 1988, 1993, and 1997 field sampling efforts were screened for COPCs. The results of that screen are presented in Table 10-1. The HHRA and ERA screening methodology are discussed in Section 4 and presented in detail in Appendices D and F,

respectively. Because the maximum concentrations exceeded the RBCs Cs-137, U-235, and U-238 were retained as COPCs for the HHRA. Also, 1,1,2-TCA was retained as a COPC for the ERA because an EBSL for this contaminant has not yet been established. Barium, beryllium, cobalt, copper, manganese, and vanadium were retained as COPCs for the ERA because the maximum concentrations exceeded the EBSLs. Other detected contaminants, including mercury, Sr-90, and U-234, were screened out. As discussed in the footnotes of Table 10-1, and per agreement with the Agencies, the screening levels used were Environmental Protection Agency (EPA) Region 9 preliminary remediation goals (PRGs) and a January 3, 1996 letter from Jeff Fromm. The mercury concentrations were all less than the preliminary remediation goals listed in EPA Region 9 PRGs, and the Sr-90 and U-234 levels were less than the levels in the Jeff Fromm letter[1].

For LCCDA-02, the soil data collected from the 1988 and 1997 field sampling efforts were screened for COPCs. The COPCs resulting from that screening are presented in Table 10-2. Only Ra-226 was retained as a COPC for the HHRA because the maximum concentration exceeded the RBC. The solvent 1,1,2-TCA was retained as a COPC for the ERA because an EBSL has not yet been established for this contaminant. Beryllium, copper, and manganese were also retained as COPCs for the ERA because the maximum concentrations exceeded the EBSLs. The complete screening tables are contained in Appendix C.

10.5 Risk Assessment

Table 10-3 presents exposure point concentrations. Appendix C contains both summary statistics and exposure point concentrations supporting this assessment.

10.5.1 LCCDA-01 Human Health

The total estimated carcinogenic risk for potential future residents at LCCDA-01 is 5E-05, which falls within the target risk range of 1E-04 to 1E-06. The primary contributor to risk is Ra-226 (5E-05), through the external radiation exposure route. Noncarcinogenic hazards were not evaluated for this site because no noncarcinogenic COPCs were retained in the HHRA for LCCD-01.

The total risk to current occupational workers at LCCDA-01 is 6E-05, and the total risk to future occupational workers is 3E-05, both through the external radiation exposure route to Ra-226.

The radionuclide Ra-226 was detected at a maximum detection of 6.99 pCi/g at 0 to 0.15 m (0 to 0.5 ft). Previous studies have shown that Ra-226 levels can be overestimated by gamma spectrometric analysis because of interference from U-235 (Giles 1998a and 1998b). When corrected for this interference, the Ra-226 detection appears to be similar to background levels and is not considered a risk.

Complete HHRA results are presented in Appendix E.

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[1] Personal communication from Jeff Fromm, Ph.D., Idaho Department of Environmental Quality environmental toxicologist, "Radionuclide Risk-Based Concentration Tables," January 3, 1996.

Table 10-1. Soil Contaminant Screening Process for Operable Unit (OU) 10-04, LCCDA-01 (1988, 1993, 1997).

		Step 1		Step 2	Step 3		Step 4		Site COPC	
Detected Contaminants	Max. Source Concentration (mg/kg or pCi/g)	INEEL Background Concentration (mg/kg or pCi/g)	Max. Concentration > Background	Nontoxic Metal	Region 9/3 RBC (mg/kg or pCi/g)	Max. Concentration > RBC	INEEL EBSL (mg/kg or pCi/g)	Max. Concentration > EBSL	HHRA	ERA
1,1,2-Trichloroethane	9.00E-03	NA	NA	No	8.43E-01	No	No EBSL	No EBSL	No	Yes
Barium	4.03E+02	3.00E+02	Yes	No	5.48E+03	No	1.10E+01	Yes	No	Yes
Beryllium	3.30E+00	1.80E+00	Yes	No	1.56E+02	No	7.14E-01	Yes	No	Yes
Cobalt	1.17E+01	1.10E+01	Yes	No	4.69E+03	No	4.27E-01	Yes	No	Yes
Copper	2.40E+01	2.20E+01	Yes	No	2.90E+03	No	2.11E+00	Yes	No	Yes
Cs-137	9.20E+00	8.20E-01	Yes	No	2.30E-01	Yes	4.95E+03	No	Yes	No
Manganese	6.83E+02	4.90E+02	Yes	No	1.60E+03	No	1.05E+01	Yes	No	Yes
Ra-226	6.99E+00	NA	NA	No	5.50E-03	Yes	2.04E+01	No	Yes	No
U-235	2.39E-01	NA	NA	No	1.30E-01	Yes	2.27E+01	No	Yes	No
U-238	5.53E+00	1.40E+00	Yes	No	6.70E-01	Yes	2.32E+01	No	Yes	No
Vanadium	4.50E+01	4.50E+01	Yes	No	5.48E+02	No	1.49E+00	Yes	No	Yes

Source: Waste Area Group (WAG) 10, OU 10-04 Database.

"NA" in Step 1 indicates that a background value is not available.

"No RBC" indicates that an Environmental Protection Agency (EPA) Region 9 or 3 risk-based concentration based on residential soil ingestion is not available.

"No EBSL" indicates that an Idaho National Engineering and Environmental Laboratory (INEEL) ecologically based screening level is not available.

Radionuclide risk-based concentrations were taken from a personal communication from Jeff Fromm, Ph.D. an environmental toxicologist, entitled "Radionuclide Risk-Based Concentration Tables," January 3, 1996.

Sr-89 was removed from the HHRA COPC list because it has a half-life of less than five years.

Arsenic was removed from the ERA & HHRA COPC lists because detected levels are within the arsenic regional background ranges discussed in Appendix K.

Table 10-2. Soil Contaminant Screening Process for Operable Unit (OU) 10-04, LCCDA-02 (1988, 1997).

		Step 1		Step 2	Step 3		Step 4		Site COPC	
Detected Contaminants	Max. Source Concentration (mg/kg or pCi/g)	INEEL Background Concentration (mg/kg or pCi/g)	Max. Concentration > Background	Nontoxic Metal	Region 9/3 RBC (mg/kg or pCi/g)	Max. Concentration > RBC	INEEL EBSL (mg/kg or pCi/g)	Max. Concentration > EBSL	HHRA	ERA
1,1,2-Trichloroethane	8.00E-03	NA	NA	No	8.43E-01	No	No EBSL	No EBSL	No	Yes
Beryllium	1.80E+00	1.80E+00	Yes	No	1.56E+02	No	7.14E-01	Yes	No	Yes
Copper	2.70E+01	2.20E+01	Yes	No	2.90E+03	No	2.11E+00	Yes	No	Yes
Manganese	5.45E+02	4.90E+02	Yes	No	1.60E+03	No	1.05E+01	Yes	No	Yes
Ra-226	2.60E+00	NA	NA	No	5.50E-03*	Yes	2.04E+01	No	Yes**	No

Source: Waste Area Group (WAG) 10, Operable Unit (OU) 10-04 Database.

"NA" in Step 1 indicates that a background value is not available.

"No RBC" indicates that an Environmental Protection Agency (EPA) Region 9 or 3 risk-based concentration based on residential soil ingestion is not available.

"No EBSL" indicates that an INEEL ecologically-based screening level is not available.

* Radionuclide risk-based concentrations were taken from a personal communication from Jeff Fromm, Ph.D. an environmental toxicologist, entitled "Radionuclide Risk-Based Concentration Tables." January 3, 1996.

** Not considered a risk as discussed in section 10.5.2 and more completely in section 11.4.

Table 10-3. Summary Exposure Point Concentrations for LCCDA-01 and LCCDA-02 (concentration units are mg/kg or pCi/g; bin depths are in feet.)

COPC	0-0.5 ft	0-4 ft	0-10 ft	0-14 ft
LCCDA-01				
1,1,2-Trichloroethane	NA	NA	5.40E-03	NA
Barium	4.03E+02	4.03E+02	3.55E+02	NA
Beryllium	3.30E+00	3.30E+00	2.92E+00	NA
Cobalt	8.70E+00	8.70E+00	9.88E+00	NA
Copper	2.26E+01	2.26E+01	2.34E+01	NA
Cs-137	5.00E+00	8.68E+00	3.47E+00	5.1E+00
Manganese	4.00E+02	4.68E+02	5.69E+02	NA
Ra-226	6.99E+00	8.74E-01	3.50E-01	2.25E+00
Sr-89	1.81E+00	2.26E-01	9.05E-02	5.82E-01
U-235	1.25E-01	2.25E-01	8.99E-02	1.33E-01
U-238	5.10E+00	5.48E+00	2.19E+00	3.14E+00
Vanadium	3.46E+01	3.46E+01	3.82E+01	NA

COPC	0-0.5 ft	0-4 ft	0-10 ft
LCCDA-02			
1,1,2-Trichloroethane	NA	NA	4.80E-03
Beryllium	NA	NA	1.08E+00
Copper	NA	NA	1.62E+01
Manganese	NA	NA	3.27E+02
Ra-226	2.20E+00	2.75E-01	1.10E-01

10.5.2 LCCDA-02 Human Health

Human health risks based on the future residential scenario are 5E-5, which falls in the target 1E-4 to 1E-6. This risk comes from the external radiation exposure route to Ra-226. Noncarcinogenic hazards were not evaluated for this site because no noncarcinogenic COPCs were retained in the HHRA for LCCDA-02.

The total estimated risk to current occupational workers is 6E-05. This risk comes from Cs-137 at LCCDA-01 and Ra-226 at both LCCDA-01 and -02, through the external radiation exposure route.

The total estimated risk to future occupational workers is 3E-05. This risk comes from the external radiation exposure to Ra-226 at both LCCDA-01 and -02.

As with LCCDA-01, Ra-226 was detected at a maximum detection of 6.99 pCi/g at 0 to 0.15 m (0 to 0.5 ft). Previous studies have shown that Ra-226 levels can be overestimated by gamma spectrometric analysis because of interference from U-235 (Giles 1998a and 1998b). This is further discussed in

Section 11.4. When corrected for this interference, the Ra-226 detection appears to be similar to background levels, and is not considered a risk.

Complete HHRA results are presented in Appendix E.

10.5.3 LCCDA-01 Ecological

The COPCs for the ERA are 1,1,2-TCA and metals for the surface and subsurface soils. Only COPCs with hazard quotients (HQs) greater than 10 will be retained for further evaluation in the ERA. These HQs and COPCs are presented in Table 10-4. The COPCs with HQs less than or equal to 10 are eliminated from the ERA because they pose a low risk to ecological receptors and no longer need to be evaluated. No toxicity information could be found to assess ecological risk from exposure to 1,1,2-TCA. This compound is highly volatile, was detected at a relatively low concentration (0.009 mg/kg), and is likely to have undergone some biodegradation since its detection in 1988. Given these conditions, it is unlikely that ecological receptors could be exposed to 1,1,2-TCA at levels that would contribute significantly to ecological risk at this site.

The HQs for barium, cobalt, copper, and manganese ranged from 1 to 10. Risks from these contaminants to reptiles, amphibians, and invertebrates could not be evaluated because of the lack of toxicity data to develop toxicity reference values. Risks to plants could not be evaluated for cobalt, and birds could not be assessed for threats from exposure to barium or beryllium. Risks from manganese and mercury to reptiles, amphibians, and invertebrates could not be evaluated because of the lack of toxicity data to develop toxicity reference values.

The HQs for the COPCs at LCCDA-01 are discussed below:

- The HQs for exposure to barium ranged from 3 for the deer mouse (M422), to 5 for the pygmy rabbit (M122A).
- Beryllium HQs at LCCDA-01 were all below 1.0.
- The only HQ>1 for exposure to cobalt was a 4 for the pygmy rabbit (M122A). However, the exposure point concentration ranges from 8.7 mg/kg in the surface soil to 9.88 mg/kg in the subsurface soil, which falls below the Idaho National Engineering and Environmental Laboratory (INEEL) maximum background concentration for cobalt (12.5 mg/kg). Therefore, an average species may be exposed to the same magnitude of risk from exposure to background. This contaminant was eliminated as a COPC, because the HQs fell below 10, which indicates a low risk to ecological receptors.

Table 10-4. Summary of ERA HQs for LCCDA-01

COPC Receptors	Barium HQs	Cobalt Manganese HQs	Copper HQs	Manganese HQs
Deer mouse	3	—	—	—
Plants	—	—	—	10
Pygmy rabbit	5	4	1	9

COPCs with HQs less than one are not presented in this table.

- The HQ for exposure to copper was a 1 for the pygmy rabbit (M122A). The EPC ranges from 22.6 mg/kg in the surface soil to 23.4 mg/kg in the subsurface soil. The INEEL background concentration for copper is 22 mg/kg. Therefore, an average species may be exposed to a similar magnitude of risk from exposure to background concentrations. This contaminant was eliminated as a COPC because the HQs fell below 10, which indicates a low risk to ecological receptors.

- The HQs for exposure to manganese ranged from 9 for the pygmy rabbit (M122A), to 10 for plants (i.e., all vegetation). The exposure point concentration ranges from 400 mg/kg in the surface soil, to 569 mg/kg in the subsurface soil. The INEEL background concentration for manganese is 490 mg/kg. This contaminant was eliminated as a COPC because the HQs were equal to or fell below 10, which indicates a low risk to ecological receptors.

- Vanadium HQs at LCCDA-01 were all below 1.0.

The risk evaluation indicates that exposure to surface and subsurface soils at LCCDA-01 poses limited risk to ecological receptors from exposure to soils. No COPCs were retained for further evaluation in the ERA for this site. Complete ERA results are presented in Appendix F.

10.5.4 LCCDA-02 Ecological

The COPCs for the ERA are 1,1,2-TCA and metals for subsurface soils. Only COPCs with HQs greater than 10 will be retained for further evaluation in the ERA. These HQs and COPCs are presented in Table 10-5. The COPCs with HQs less than or equal to 10 are eliminated from the ERA because they pose a low risk to ecological receptors and no longer need to be evaluated. The HQs for copper and manganese ranged from 1 to 10. No toxicity information could be found to assess ecological risk from exposure to 1,1,2-trichloroethane. This compound is highly volatile, was detected at a relatively low concentration (0.008 mg/kg), and is likely to have undergone some biodegradation since its detection in 1988. Given these conditions, it is unlikely that ecological receptors could be exposed to 1,1,2-trichloroethane at levels that would contribute significantly to ecological risk at this site.

Risks from exposure to copper and manganese to reptiles, amphibians, and invertebrates could not be evaluated because of the lack of toxicity data to develop toxicity reference values. Risks to birds could not be assessed for threats from exposure to beryllium.

Table 10-5. Summary of ERA HQs for LCCDA-02

COPC Receptors	Copper HQs	Manganese HQs
Plants	—	6
Pygmy rabbit	1	7

COPCs with HQs less than one are not presented in this table.

The HQs for the COPCs at LCCDA-02 are discussed below:

- Beryllium HQs at LCCDA-02 were all below 1.0.

- The HQ for exposure to copper was a 1 for the pygmy rabbit (M122A). The EPC in the subsurface soil is 16.2 mg/kg, which is below the INEEL background concentration for copper (22 mg/kg). Therefore, an average species may be exposed to the same magnitude of risk from exposure to background concentrations. This contaminant was eliminated as a COPC because the HQs fell below 10, which indicates a low risk to ecological receptors.

- The HQs for exposure to manganese ranged from 6 for plants (i.e., all vegetation), to 7 for the pygmy rabbit (M122A). The exposure point concentration in the subsurface soil is 327 mg/kg. The INEEL background concentration for manganese is 490 mg/kg. Therefore, an average species may be exposed to the same magnitude of risk from exposure to background concentrations. This contaminant was eliminated as a COPC because the HQs fell below 10, which indicates a low risk to ecological receptors.

The risk evaluation indicates that LCCDA-02 has limited risk to ecological receptors from exposure to soils from this site. No COPCs were retained for further evaluation in the ERA for LCCDA-02. Complete ERA results are presented in Appendix F.

10.5.5 Native American

The INEEL is within the aboriginal territories of the Shoshone-Bannock Tribes. A wide variety of natural and cultural resources and areas that directly reflect tribal cultural heritage and native landscape ecology are preserved at the INEEL. These resources are important in maintaining tribal spiritual and cultural values and activities, oral tradition and history, mental and economic well being, and overall quality of life. Archaeological sites that are certainly important to tribal cultural heritage and values are present in the vicinity of the LCCDA, many exhibiting great antiquity (e.g., 10,000–12,000 years old).

Shoshone-Bannock Tribal Elders and Tribal Risk Assessment Committee members were taken to visit the LCCDA area once during a tour in March 2000. Their report (see Appendix A) identified no specific Native American concerns at LCCDA. However, the limited ecological risk posed by exposure to soils within the LCCDA would probably be viewed as a potential risk within the general holistic world view that is presented in the report. These concerns should help to prompt remedial action if future monitoring indicates any rise of risk levels above threshold values established to protect human health and the environment.

10.6 Uncertainties

Insufficient toxicological data exist for 1,1,2-trichloroethane. Therefore, the potential ecological risks posed by this COPC could not be evaluated. Also, TRVs could not be developed for some ecological receptors and the potential ecological effects may be underestimated.

To limit the amount of information repeated in individual uncertainty sections, only the specific uncertainties associated with each site or area will be discussed within its section. General uncertainties associated with the HHRA are in Appendix D; general uncertainties associated with the ERA can be found in Appendix F.

10.7 Conclusions and Recommendations

Human health risks at both LCCDA-01 and LCCDA-02 are within the 1E-4 to 1E-6 target risk range for human health. The site does not pose risk to ecological receptors, therefore, this site is recommended for no further action and will not be evaluated in the feasibility study.

10.8 References

DOE-ID, April 1999, *Work Plan for Waste Area Groups 6 and 10 Operable Unit 10-04 Comprehensive Remedial Investigation/Feasibility Study*, DOE/ID-10554, Rev. 0, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

DOE-ID, July 1997, *Field Sampling Plan for Operable Unit 10-04*, DOE/ID-10564, Rev 1, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho.

EG&G, October 1993, *Sampling and Analysis Plan for the OU 10-01 Track 2 Investigation: Liquid Corrosive Chemical Disposal Area*, EGG-ER-10552, Rev. 1, Idaho National Engineering and Environmental Laboratory, EG&G Idaho, Idaho Falls, Idaho.

Giles, J.R., February 18, 1998a, *TAN TSF-07 Pond Radium-226 Concentrations and Corrections,* Engineering Design File INEEL/INT-98-00505, ER-WAG1-108, Rev. 05, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

Giles, J.R., 1998b, "Radium-226 at ARA-01, -02, -16, and –23, Waste Area Group 5," Engineering Design File INEEL/INT-98-00850, ER-WAG5-111, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, in Holdren et al. 1999, Appendix J.

Hull, L. C., C. A. Loehr, B. H. Becker, M. L. Paarmann, 1994, *Preliminary Scoping Track 2 Summary report for the Liquid Corrosive Chemical Disposal Area, Operable Unit 10-01*, INEL-94/0075, Rev. 1. (Formerly EGG-ER-10956)